A Uniquely Alabama Workforce Concept

Presented to
The Alabama Space Authority
September 28, 2021
Auburn, Alabama

Chris Crumbly/IDEA Executive Director

System Engineering Technician (SET) 2-Year Degree

USG Industrial Base Investment

CORNERSTONE
Cornerstone of the American Military competitive edge

Academic Partners

CALHOUN COMMUNITY COLLEGE

Digital Engineering Applications for Industry

VictorySolutions

Non-Profit Implementation

Institute for Digital Enterprise Advancement

System Engineering Technology Degree Goals	
Problem Statement	• Technology Development takes too long in the U.S. Our adversaries are rapidly advancing in high-tech fields including hypersonics. • The US Government has increasingly turned to Model Based Systems Engineering (MBSE) to accelerate R&D by efficiently automating manual analysis processes and integrating disparate digital tools.
Challenge	• The supply of a competent systems engineering technical workforce does not meet demand for a trained workforce that can build, manipulate, and exploit MBSE tools in the needed SysML (Systems Modeling Language) format
The SET Approach	• Follow the analog from Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) technician discipline and develop a new 2-year degree Systems Engineering Technician training program with the pathfinder at Calhoun Community College
Objective	• Fill increasing government and industry demand for MBSE/digital engineering capabilities to reduce product time to market • implement 24-month SET degree through community colleges which should appeal to incoming freshmen and career transitioning professionals including returning veterans.
Plan of Action	• Initiate a pathfinder instruction program at Calhoun (Aug 21) • Expand through University/Community College nodes • Move upstream to high schools and downstream to Universities

Systems Engineering Technician (SET)

Timeline

2018 – Ron Porter and Chris Crumbly develop the MBSE Center of Excellence Concept

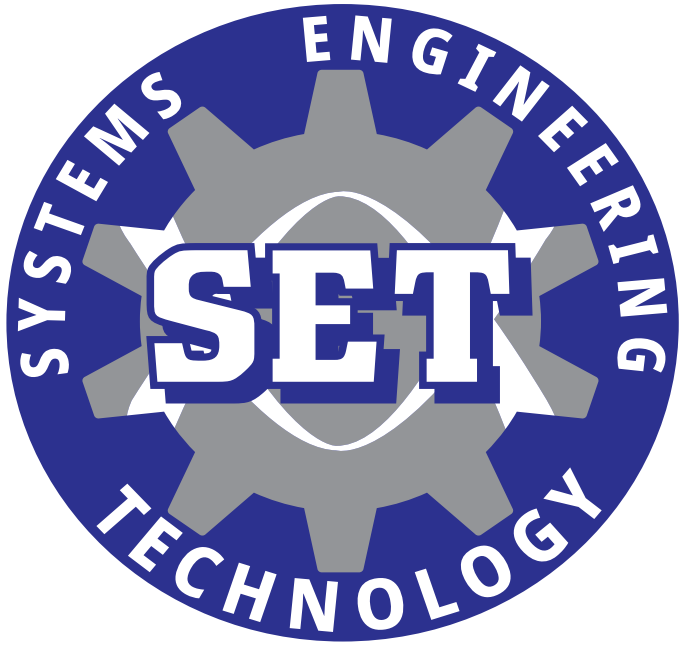
2019 – Kris McGuire of Victory Solutions develops a concept for CM/DM in the Community College System for returning veterans

2019 – Crumbly and McGuire combined the concepts to provide MBSE Instruction within the Community College system

2020 – OSD/IBAS awarded our team a 5-year OTA to develop the Systems Engineering Technician curriculum

- Auburn University
- Victory Solutions
- Calhoun Community College
- IDEA

Calhoun College SET Logo



Effective Model Based System Engineering (MBSE) Workforce Development

Institute for Digital Enterprise Advancement (IDEA) – *A non-profit, national collaborative center for identifying, sharing, and recommending Digital Engineering and Manufacturing best practices and applications in the workplace*

IDEA applies a Helix framework to Model Based System Engineering

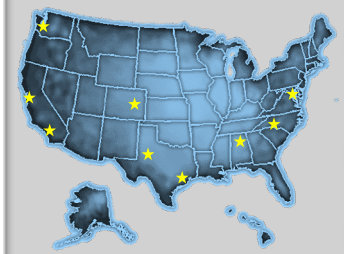
- ❑ Postsecondary Programs
  - 2-Year SET Degree
  - Internships & Apprenticeships
  - OSCMP Certifications
  - Career Placement
- ❑ Working professionals
  - SET derived Courses
  - OSCMP Certifications
- ❑ Undergraduate & Graduate
  - SET derived Labs/Projects
  - SET derived Electives
  - OSCMP Certifications

Partners

CALHOUN COMMUNITY COLLEGE

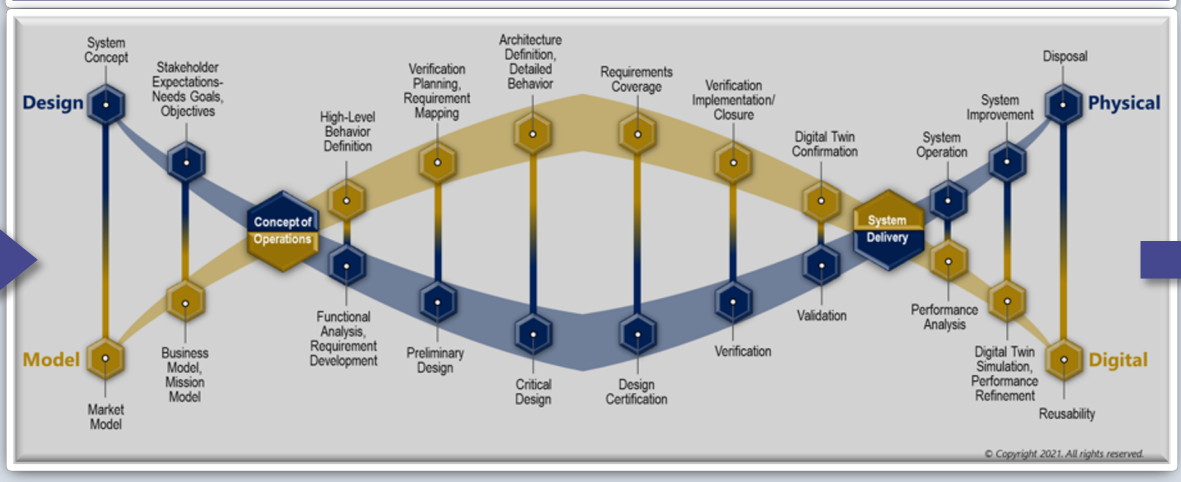
Victory Solutions

IDEA Industry/Community Sponsorships



- ❑ Sponsor IDEA education Nodes near MBE/MBSE centers of excellence
- ❑ Sponsor internships & apprenticeships
- ❑ Employ SET Graduates

MBSE Helix: the lifecycle interrelationship of virtual model & physical design "V's"



Professional Certificate Courses Across Range of OCSMP Certification

Manager/Non-Modeler Introduction to MBSE (8 course hours) – *What MBSE is, what it does, how it can be implemented.* Provides industry "use" context, terminology, and application emphasizing benefits and challenges as well as an overview of MBSE implementation approaches including SysML® for modelers and/or system engineers. *Applicable to all OCSMP Modeler certifications.*

Basic MBSE Modeling (40 course hours) – *Best practice modeling building blocks and applications across the system engineering life cycle.* Expands on Introduction to demonstrate model interactions/behaviors application across physical/digital system engineering life cycle of requirements, design, analysis, verification and validation. *Applicable to OCSMP Modeler 1.*

Advanced MBSE Modeling (60 course hours) – *Leverage tool capabilities to build models that enhance design efficiency and collaboration across organizations.* Expands on Introduction and Basic courses to allow participants to build SysML® modeling competencies using a basic digital model. *Applicable to OCSMP Modeler 1 and Modeler 2.*

Systems Engineering Technology (SET) Degree

- ❑ 2-Year System Engineering Technician Associates Degree
  - SysML Modeling
  - Database Management
  - Systems Engineering Process & Concepts
- ❑ Practical applied learning from latest industry lessons learned

SET Placements & Capability Enhancement

- ❑ Counseling during Internships/Apprenticeships
  - Student assistance/support
  - Employer feedback to SET curriculum improvement
- ❑ Graduate placement assistance

www.idea-set.org

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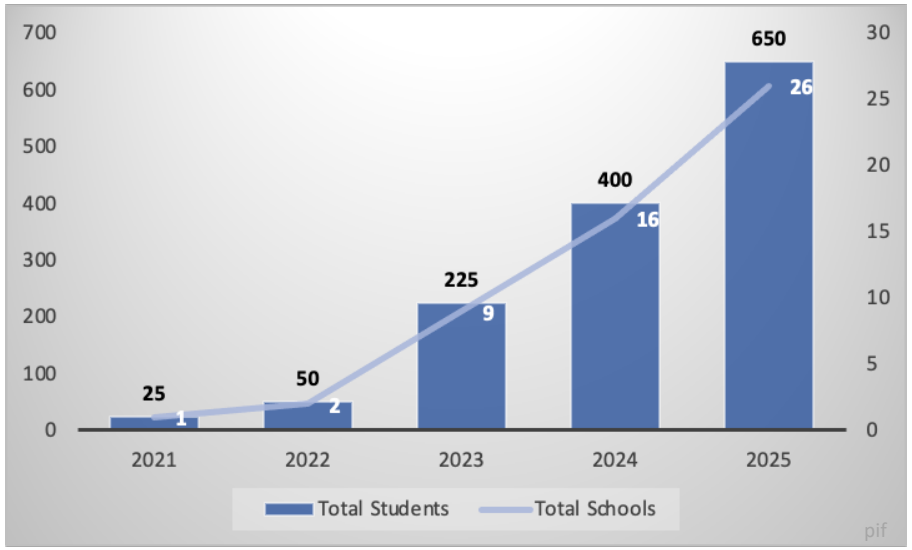
CAD/CAM Analog

- Systems modeling now is in the same state as CAD/CAM in the early years
  - Personnel skill similarities; complex tool manipulation, attention to detail, understanding of technical field
  - Employer assumption similarities: Employers currently expect, as they did early with CAD/CAM, engineers to be fluent with current modeling tools
  - Tool reality similarity: Tool advancement and complexity is and will continue to exceed practicing Engineers' ability to keep up
  - Community Colleges developed CAD Technician programs to fill the gap

- As in CAD/CAM, there is an opportunity for tool application specialists
  - Engineers must focus on the eventual product not the modeling tool
  - Modelers have a near development level of understanding of the software tools, operate those tools, and apply tech understanding and access to knowledge base to find solutions to tool-based issues.
  - We do not have, but we need, a pool of trained technicians for systems modeling
  - IDEA has created a CAD/CAM designer analog for Systems Modeling

Community Colleges can fill the gap once again with SET

Systems Engineering Technician Data



SET Projections

Huntsville, AL Job Postings on *indeed.com* (4/7/21)

- 2600+ Systems Engineering Jobs
- 354 are entry level
- 296 mention Model Based Systems Engineer (>500 9/26/21)
- 124 mention MBSE (>167 9/26/21)

Current academic instruction is not keeping up with the demand for MBSE specialists

- SET is a 5-year plan to introduce a pathfinder curriculum and expand in the region and beyond
- Computer modeling and simulation is changing how engineering is practiced
- Model-Based Systems Engineering (MBSE) is one of the primary accelerators in the digital engineering advancement
- 4-year engineering curricula are structured such that MBSE is not typically introduced until a student reaches the master's degree level.
- *The SET degree will produce an entirely new skillset between data administration and engineering*
- SET is scalable, repeatable, and the North Alabama region is an excellent pathfinder.
- SET will introduce workforce pathways upstream into High Schools and move modeling instruction downstream into four-year Universities

Mission

Enable and accelerate the incorporation of Digital Engineering and Manufacturing into the workplace.

Vision

Provide a National collaborative center for identifying, sharing, and recommending best practices and solutions in Digital Engineering and Manufacturing

Workforce development

Systems Engineering Technology (SET) AAS Degree
Major Course Requirements

			Credits
INTRO	CIS 134	IT Fundamentals *(CompTIA ® ITF+)*	3
	SYS 101	Introduction to Systems Engineering	3
SECURITY	CIS 199	Network Communications *(CompTIA ® Network+)* **OR**	3
	CIS 270	Cisco CCNA I	
	CIS 280	Network Security *(CompTIA ® Security+)*	3
PROGRAMMING	CIS 202	Python Programming	3
	CIS 207	Introduction to Web Development	3
	CIS 209	Advanced Web Design	3
	CIS 251	C++ Programming	3
	CIS 285	Object-Oriented Programming	3
SysML	SYS 231	Systems Modeling I	3
	SYS 232	Systems Modeling II	3
	SYS 233	Systems Modeling III	3
DATABASE	CIS 222	Database Management Systems	3
	SYS 221	Database Management for Systems Engineering	3
CAPSTONE	SYS 241	Dynamic Data Visualization Applications	3

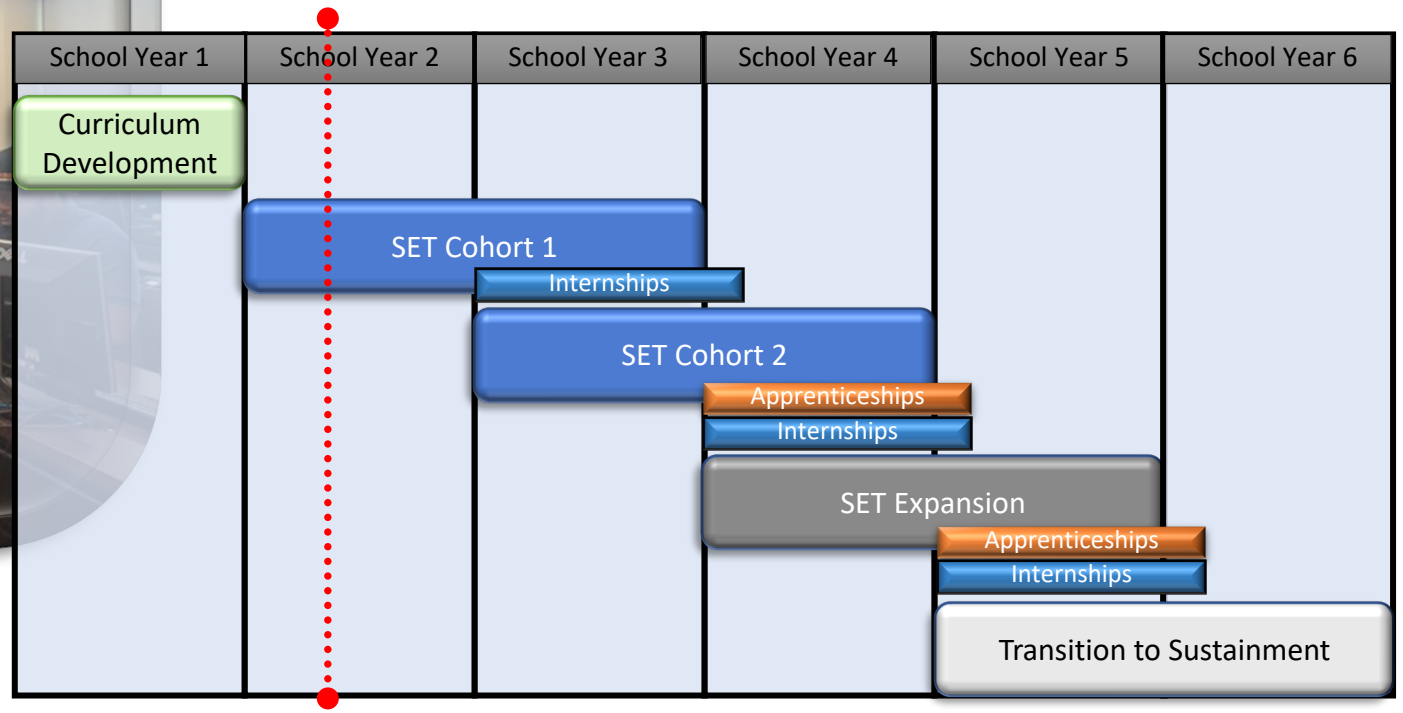
SET Program: 6-Course Overview

Course Complete
Ready for Instruction

Course Outlines Established – Requires Curriculum Development

Course 1: Introduction to Systems Engineering	Course 2: Systems Modeling I	Course 3: Database Management for Systems Engineering	Course 4: Systems Modeling II	Course 5: Systems Modeling III	Course 6: Dynamic Data Visualization Applications
Yr1 Sem1 Fall 2021	Yr1 Sem2 Spring 2022	Yr2 Sem1 Fall 2022	Yr2 Sem1 Fall 2022	Yr2 Sem2 Spring 2023	Yr2 Sem2 Spring 2023
Module 1: Systems Thinking	Module 1: Understanding a Model	Module 1: Essential Database Management Concepts	Module 1 Organizing a Model Using Basic SysML Constructs	Module 1 Building a Package Diagram Using a Full Set of SysML Constructs	Module 1 Role of Data Visualization In a Model Manipulation and Communication
Module 2: The product and product life cycle	Module 2: Building a MBSE model	Module 2: Database Analysis and Design	Module 2 Building a Structural Model	Module 2 Building a Requirements and Use Case Diagram Using a Full Set of SysML Constructs	Module 2 Use Data Visualization Tools
Module 3: Engineering a System	Module 3: SysML Diagram Types	Module 3: Database Implementation	Module 3 Building a Parametric Model	Module 3 Building a Block Definition and Internal Block Diagram Using a Full Set of SysML Constructs	Module 3 Use Various Data Visualization, SysML Programming, and Web Development Tools to Store and Visualize Data and Views and Manage Models
Module 4: Systems engineering in the product life cycle	Module 4: Requirement Development	Module 4: Designing and Building a simple Database suitable for MBSE	Module 4 Building a Behavioral Model	Module 5 Defining and Using Constraints On Diagrams	Module 4 Build an Interactive Website Suitable For the Interchange of Data In an MBSE Context
Module 5: Systems engineering and the SET in the life cycle			Module 5 Customizing a Model and Understanding Allocation Relationships	Module 5 Building an Activity, Sequence and State Machine Diagram Using a Full Set of SysML Constructs	

SET Implementation Schedule



- SET Cohort 1 Instruction began August 2021 [35 students]
- Internship 1 begins May 2022

- SET Cohort 2 begins August 2022
- Internship 2/Apprenticeship 1 begins May 2023

Professional Education Opportunities- IDEA

1. Specialists to handle the complex MBSE modeling and modeling IT overhead (SE Techs)
   A. Associate of Applied Science Degree in Systems Engineering Technology-
      1) Currently offered at Calhoun Community College, expansion across the US is expected
      2) Includes instruction in System Engineering as well as MBSE tools, and languages
      3) Prep for OMG Certified Systems Modeling Professional Level- Intermediate
      4) Student internships with MBSE implementing organizations to provide real experience
   B. Continuing Education through IDEA Academy

2. System Engineers familiar with MBSE and capable of creating and interpreting models
   A. Certificate Program at Calhoun Community College
      1) Prep for OMG Certified Systems Modeling Professional Level- Intermediate
      2) Education in the relationship of the MBSE to System Engineering practices
   B. Short courses in MBSE familiarization and specific tools and languages (ala carte)

3. Project Team Members who are aware and understand the use of MBSE
   A. Short course in MBSE familiarization and relationships with other project functions (40 hours)

4. Management who understand the best implementation of MBSE for their company
   A. Short course in MBSE implementation, benefits, implications, and costs (8 hours)
   B. Consultation in specific implementation as desired

Working Together Across Alabama

INNOVATE ALABAMA

ALABAMA WORKS!

ALABAMA COMMUNITY COLLEGE SYSTEM

AMIIC

ADVANCED MANUFACTURING INNOVATION AND INTEGRATION CENTER

IDEA Institute for Digital Enterprise

Alabama Defense Advanced Manufacturing Community (ADAMC)

SUPPORTING ALABAMA'S DEFENSE INDUSTRIAL BASE & ENHANCING SUPPLY CHAIN RESILIENCY

Federal Partners

Universities

Industry

Summary

Questions?

Can this program benefit your organization?

Interns ◦ Apprentices ◦ Graduates

Would you consider supporting SET?

Advisor ◦ Mentor ◦ Advocate